REMARKS

Claim 1 has been object to due to informalities. Claim 1 has been amended in accordance with the Examiner's suggestions.

Claims 1-33 have been rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. Claim 1 has been amended to obviate the Examiner's rejection.

Claim 1 as now amended is directed to a metalworking fluid from heavy alkylate, comprising, residual fraction having C22 – C26 carbon atom of detergent class alkyl benzene in the concentration range of 40 to 85.68 weight percent of the metal working fluid. The metalworking fluid also comprising at least one sulfonate/oleate class emulsifier in the range of 10 to 37.98 weight percent of the metalworking fluid, synergistic combination of various additive components including, at least one triglyceride vegetable oil type lubricity booster component in the concentration range of 2-10 weight percent of metal working fluid, a phenol/amine type antioxidant component in the concentration range of 0.005-0.05 weight percent, a phenolic fungicide component in the concentration range of 0.005-0.05 weight percent, an organic sulfide/phosphosulfide extreme pressure additive component in the concentration range of 0.005-0.05 weight percent, and a triazole/sulfonate type antirust component in the concentration range of 0.005-0.05 weight percent, alcoholic co-surfactant component in the range of 1-10 weight percent of metal working fluid, a sulfonate/sulfate coupling agent in the range of 0.5 to 1.0 weight percent of metal working fluid, alkali earth metal salt component in the range of 0.5-1.0 weight percent of metal working fluid, such that when the fluid concentrate is converted into emulsion by stirring it in 60 to 90 weight percent of water. The emulsion is then useful as a general purpose soluble cutting oil that acts as a

coolant/engineering aid in metalworking, has less toxicity than mineral based oil and adds value to a waste product, i.e. heavy alkyl benzene

In paragraph [0040] of the Applicants' publication, U.S. Patent Application Publication No. 20050215440, it describes the mixture as being homogenized and conditioned. The emulsion is then prepared by mixing the concentrate with H_2O with vigorous agitation. One skilled in the art would understand this description is equivalent to the language used in claim 1.

Heavy alkyl benzene (HAB) [oral LD (50) is 15 g/kg] is significantly less toxic than mineral oil [oral LD(50) is 100 mg/kg (rodent)]. Only the oil component is responsible for toxicity. The other component is emulsifier. In the case of HAB based emulsion, the emulsifier is HAB sulfonate or oleate, which are non-toxic as per OSHA list but in case of mineral oil, the commonly used emulsifier is petroleum sulfonate, which is a toxic substance as per OSHA list. So, emulsion in water from HAB based cutting oil concentrate is less toxic than emulsion in water from mineral oil based cutting oil concentrate. This invention further provides a suitable new application for heavy alkyl benzene as a by-product to increase its value. Heavy alkyl benzene has no specific use and is available in market at very low cost while soluble cutting oil from HAB has very specific use and market value is three to five times higher than HAB.

Claims 1-33 have been rejected under 35 U.S.C. §112, second paragraph, as being indefinite. Claim 1 has been amended to obviate the Examiner's rejection.

There are two types of value added, the first is ecological to provide a less toxic product to the society and the second is financial where low cost material is converted into high cost material, which can compensate the monetary loss due to the side reaction during production of detergent class alkylate (LAB). Thus, the Applicants' respectfully request that the Examiner's rejection be withdrawn.

Claims 1-12 and 34 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Anantaneni, U.S. Patent No. 6,630,430, in view of Boffa, U.S. Patent No. 5,804,537; Tanaka, U.S. Patent No. 6,245,725 B1; Camenzind, U.S. Patent No. 7,026,438 B2; Van Dam, U.S. Patent No. 6,784,142 B2; Matsushita, U.S. Patent No. 5,741,763; Zoch, U.S. Patent No. 3,902,868; and Otaki, U.S. Patent No. 4,765,917.

The Examiner's rejection is respectfully traversed.

The Applicants' invention is directed to a metalworking fluid/soluble cutting oil from waste product heavy alkyl benzene. This invention was not taught or even suggested by a combination of any of the above prior art references.

Anantaneni, U.S. Patent No. 6,630,430 discloses the lubricating oil composition without experimentation, wherein the examples are based on the synthesis of alkyl benzenes. Other texts/portions of the references are related to the wide concept of detergent, alkyl benzene and its derivatives. As stated in Anantaneni (See 2nd para after examples):

> "Although the present invention has been described largely in reference to the alkylation of benzene using olefins as an alkylating agent, it should be appreciated that substituted benzenes are also useful as starting materials within the context of the present invention, provided that the chemical groups appended to the benzene ring are not prohibitively de-activating of the benzene ring structure. In this regard, toluene is a functionally equivalent starting material, which may be used in place of all or part of the benzene employed. Other substituted benzenes such as xylene are also useful in this regard, as well as ethyl benzene, propylbenzene, and butylbenzene".

Thus, the '430 patent is directed to the synthesis of alkyl benzene whereas the Applicants' invention is for the composition of a metalworking fluid particularly, a soluble cutting oil and these are completely different compositions.

Alkyl Benzene is a class or group of chemicals. All alkyl benzenes can not be the same. Natural petroleum also contains alkyl benzene but petroleum can not be considered similar to alkyl benzene. Anantaneni '430 describes a particular type of alkyl benzenes, which are "2-

phenyl" derivatives (claim- 1). 2-phenyl and benzene is not one compound. The Applicants' invention is related to heavy alkylate, a residue fraction of detergent class alkyl benzene (claim 1). Detergent class alkyl benzene is chemically dodecyl benzene. It is produced by reacting propylene tetramer (dodecene) with benzene. Its residual fraction (heavy alkylate) is not restricted to 2-phenyl derivatives (such as decyl toluene or decyl 2-methyl benzene: di-alkyl benzene). Thus, both alkyl benzenes are different.

The novelty of the Anantaneni patent is an "efficient detergent" (claim 1) whereas in the Applicants' invention one point of novelty is a material "less toxic than mineral oil" (claim 1). Toxicity of mineral oil is due to its component of condense ring or poly-aromatic compound. Alkyl benzene is free from this toxicity and help in reducing pollution and unhealthy mist hazards to operators, it is different.

Anantaneni '430 also teaches a method to produce di alkyl benzenes. The Applicants' invention is on a composition of soluble cutting oil (metalworking fluid) and thus is very different.

Anantaneni '430 does not describe the aqueous solution preparation of lubricants. The Applicants' invention does describe aqueous solution/emulsion preparation and that stable emulsion is suitable for metalworking, i.e., cutting, drilling, milling, rubbing, etc.

The Anantaneni patent discloses a lubricating composition for a metal surface, especially an internal combustion engine (claim 1, 38 & 39). Anantaneni (US 6630430) patent is restricted to derivatives of 2-phenyl type of alkyl benzene (claim 1) "*in which n may be any integer between 13 and 27, and in which R.sub. 1, R.sub.2, R.sub.3, R.sub.4, and R.sub.5 are each independently selected from the group consisting of: hydrogen, a methyl group, an ethyl group, a propyl group, a butyl group, a sulfonic acid group, a sulfonate group, and a sulfonate ester group*". (Claim 1). There is no term like "fractionation" in any claim or disclosure of this

patent. During synthesis, isolation is the usual processing procedure but not fractionation. Fractionation is the usual practice for dividing a product into two or more useful product. In the subject application "alkyl benzene" is product of alkyl chain C12 or its multiple to the benzene. The residual fraction of this heavy alkylate is a mixture of similar alkyl benzene. On the other hand, the detergent of Anantaneni '430 is restricted to use of sulfonate from 2-phenyl type of alkyl benzene while in the present application emulsifier is from heavy alkylate sulfonate or oleate. Use of oleate will also reduce the toxicity. Vegetable oil is also used in the subject application. In the present application, aqueous emulsion from composition is useful for soluble cutting oil and it can not be useful for internal combustion engine as lubricant. Thus, the compositions and their purpose are quite different.

Anantaneni '430 discloses compositions comprised of alkyl benzene, having 18 to 30 carbon atoms, to enhance detergency (column 1, lines 20-25, 55-58). As per literature, sulfonate acts in different ways according to its structure and molecular weight. Sulfonate of lower molecular weight or di-sulfonate act as de-emulsifiers, sulfonate having molecular weight around 420-450 act as emulsifier, sulfonate of higher molecular weight act as industrial detergent/dispersant and sulfonate of highest molecular weight act as rust inhibitors or anti-corrosion. All sulfonates can not be same. If Anantaneni targeted "detergency" and the subject application targeted "emulsification" then the structure, degree of substitution and molecular weight range of sulfonate will all be different. In the present application, the carbon range in the alkyl chain is suitable for emulsifier. Even when carbon number overlaps, there structures are different. When the components are different, it will leads to different composition.

The Anantaneni patent discloses that *the alkyl benzenes are present in the lubricating composition from 35 to 82 wt % of the total composition (See claim 1, column 32).* That means

the composition will be used in that ratio. In the Applicants' invention, alkyl benzenes are present in 40 to 85.68 wt % and when emulsified in water in 10 to 40 % wt. The concentration of alkyl benzene will be from 4 to 8.568 (at 10 %) and 16 to 34.272 (at 40% in water). So, compositions contain alkyl benzene at quite different ratio when used.

Furthermore, Anantaneni '430 discloses the use of additives in the composition including extreme pressure additives, antioxidants and more (column 21, lines 38-45). Anantaneni does not specifically disclose the additives and the use of composition as emulsion in water as general purpose cutting oil. For examples, he mentioned "anti-oxidant" but he does not specify which ones may be used. In the subject application, additives are specified (claim 1 to 13). For example, the anti-oxidant is specified *"an antioxidant component which is an alkyl phenol, aromatic amine or substituted alkyl phenol in concentration between 50 – 500 gm/liter,* and further specified *wherein the antioxidant component is an alkyl phenol or aromatic amine or substituted alkyl phenol selected from 2, 6-ditertiary butyl phenol, 2,6- ditertiary p-cresol, Diphenylamine, Tertiary butyl phenol amino tetrazole and 2, 6-dioctyl phenylene diamine.*

The present application is quite different from Boffa, U.S. Patent No. 5,804,537 on emulsifiers (l) because Boffa discloses the "tri-metal detergent mixture" in the claims and abstract. Tri-metal detergent is not a specific word. In fact Boffa '537 uses overbased detergent mixture of a particular TBN for engine cleanliness. Boffa does not specify which detergent is used. It may be petroleum sulfonate, alkyl aryl sulfonate, caboxylates, etc. (Please see detailed description para 4 of US5804537). This paragraph is based on literature survey and patents 3,150,088, 3,150,089, 5,232,614, 4,935,576, 4,982,045, etc. Alkyl benzene sulfonate is not a finding of Boffa in US 5,804,537. It was a previously known fact. The effect of overbased sufonates as mix detergent is not adopted by Anantaneni's patent. However, the Applicants'

invention is for soluble cutting oil and here sulfonate is efficient in water-oil emulsion formation, which is non-obvious in that patent. The alkyl benzene sulfonate used by the Applicants is different from sulfonate used by Boffa or Anantaneni.

Boffa '537 uses overbased mixed detergent which may contain alkyl benzene sulfonate. The overbased detergent is useless in aqueous media or emulsion. In oil media, due to oxidation some organic acid forms and to neutralize those acids, overbased detergent or extra alkali is needed as in the case of engine lubricants, but in aqueous media overbased detergent is not required for neutralization of oxidized product.

The main function of soluble cutting oil is to keep the metal surface cool. Heat is generated during metal cutting or metal to metal friction. Water acts as a coolant and oil acts as lubricant. Due to this water-oil emulsion is used. But water can cause rusting/corrosion. A suitable emulsion can reduce rusting. Thus, the sulfonate of Boffa '537 and Anantaneni '430 is not suitable for soluble cutting oil.

Use of heavy alkyl benzene as lubricant in engine has no relation with the present invention. The metalworking fluid has entirely different uses as compared to I.C. Engine lubricants. Their additive package is also entirely different.

Boffa '537 and Anantaneni '430 selected the application and developed the alkyl benzene overbased sulfonate and alkyl benzene sulfonate accordingly. In the Applicants' invention, which is a value addition to heavy alkylate, the selection of base material is fixed. Heavy alkylate is tailored to be suitable for soluble cutting oil. Synthesis of heavy alkylate is not the purpose of the Applicants' invention. Thus, the present invention is different from Boffa and Anantaneni.

In Tanaka '725 the oiliness component is mentioned in claim 5. In the detailed description, all possible names of compounds including castor oil for oiliness are given.

Anantaneni (US 6630430) mentioned (in detailed description) friction modifier including derivatives of coconut oil. Castor oil has a peculiar characteristic of non-solubility in oil and water. It is not clear from patents of Tanaka and Anantaneni that castor oil or other additives will be useful in oil-water emulsion also. They have discussed these only for oil-soluble or single phase oil lubricants. It is non-obvious because the Applicants' invention is dealing in oil-water phase.

The amount of additive is not an absolute quantity. It depends upon the nature of base oil and application needed. Base oil and additive composition of engine oil will not be suitable for gear oil or cutting oil or greases. Additives and its amount will change with needs accordingly. The patents of Tanaka and Anantaneni are not teaching this aspect and which additive in what quantity will be needed for oil-water emulsion is not mentioned in these patents.

The present patent application is quite different from Camenzind '438 on anti-oxidant (III), antirust agent (IV) and coupling agent (V) because as per the abstract of Camenzind:

> "The invention relates to liquid sulfur-containing antioxidants and to compositions comprising them. The novel lubricant compositions comprise the reaction product of a selected group of 5-tert-butyl-4-hydroxy-3- methyl (or tert-butyl) phenyl substituted carboxylic acid esters with thiodiethylene glycol and a mono-hydroxy alcohol with a carbon chain length higher than 4 C-atoms. The novel lubricant compositions are highly resistant to oxidative degradation and are capable of reducing the negative effects of deposits, such as black sludge, in motor combustion engines, particularly spark ignition internal combustion engines."

The base oil of the Camenzind patent "a reaction product" is quite different from the base oil "heavy alkylate" of the subject application. The composition is for motor combustion engine and different from the Applicants' invention for soluble cutting oil. Antioxidant is restricted to liquid sulfur containing product, which is different from anti-oxidant of the Applicant's invention. Thus, the subject application is different from the teachings of Camenzind.

Camenzind '438 only relates to "liquid sulfur-containing antioxidants" and "reaction product of a selected group of 5-tert-butyl-4-hydroxy-3- methyl (or tert-butyl) phenyl substituted carboxylic acid esters with thiodiethylene glycol and a mono-hydroxy alcohol with a carbon chain length higher than 4 C-atoms." All antioxidants are not same and all lubricants are not same. In claims 5 and 6 of Camenzind, only the composition of the above antioxidant and lubricant is described. There is no mention of alkyl benzene based soluble cutting oil.

In column 7, line 60-66 of Camenzind:

> "The invention relates also to a method of improving the performance properties of lubricants, which comprises **adding to the lubricant at least one product as defined above.** The lubricant compositions, e.g. greases, gear fluids, metal working fluids and hydraulic fluids, may additionally contain further additives, which are added to improve further their performance properties. These include: other antioxidants, metal deactivators, rust inhibitors, viscosity index improvers, pour-point depressants, dispersants, detergents, high pressure additives and antiwear additives. Such additives are added in customary amounts, each in the range from 0.01 to 10.0% by weight."

All the additives mentioned are suitable for the particular base oil that is reaction product mentioned in Claim 1. These are not universal additives. Metalworking fluid described in this patent is also made from same base oil. Camenzind '438 does not teach that these additives will be suitable for heavy alkyl benzene (as lube base oil) based metalworking fluid. Thus, the Applicants' invention is not anticipated by Camenzind '438.

Van Dam, U.S. Patent No. 6,784,142 discloses a lubricating composition for diesel engine (claim 10 and 12). The all additives mentioned here are effective in oil phase and composition is suitable as lubricant for diesel engine. It is not clear that these additives are also suitable for water-oil emulsion phase.

Van Dam '142 also discloses a lubricating composition for diesel engine. The title is "Lubricating oil composition comprising borated and EC-treated succinimides and phenolic anti-oxidant". Here three components are essential parts that are hydrocarbon base-oil, borated

succinimide and phenolic antioxidant (claim 1). Other additional additives mentioned here are suitable in this combination. There is no teaching in this patent of what would happen if the composition is an oil-water emulsion (base), sulfonate/oleate (emulsifier) and amine (anti-oxidant), the combination mentioned in the subject application. Thus, the Applicants' invention is not obvious over Van Dam '142.

In Matsushita, U.S. Patent No. 5,741,763 the aim is to give a composition of a lubricating oil (for machines operation), which is easily separable if mixed into soluble cutting oil. This patent is not for composition of soluble cutting oil. This lubricating oil is highly hydrophobic and will not mix with even oil-water emulsion. The wear preventive agent may be added to this composition. Matsushita is not sure about the suitability of dibenzyl disulfide and its quantity. It is not mentioned. Matsushita '763 does not teach the utility of additives. The quantity of total additive is 0.01 to 5 wt % and not particularly dibenzyl disulfide. Its suitability for soluble cutting oil emulsion is not indicated. It is non-obvious for the Applicants' invention.

It is possible that Matsushita '763 only worked for oil and sulfonate composition and as per literature he has used "commercial additive pack". "Within the limits not detrimental to the objective of the present invention, a wide variety of additives conventionally used in lubricant oils, such as antioxidants, wear preventive agents, friction adjusters, metal deactivators, extreme pressure agents, rust preventives, adhesion improving agents and the like, may be added to the lubricant oil composition of the present invention." (Present invention, para 21). Only he is quoting from the literature, Matsushita has not worked with additives.

Zoch, U.S. Patent No. 3,902,868 discloses the liquid additives in vapor phase for fuel of internal combustion engine to enhance the combustion. For this purpose Zoch proposes various oxygenate or oxygen carrying liquids. Alcohol, ketone, ester and ether come in this

category. These compounds will provide additional oxygen for combustion. In the Applicants' invention, iso-propyl and other alcohol is used but as co-surfactant. This co-surfactant easily mixed with water to reduce oil water interfacial tension and helps the emulsifier in completing its action of providing stable oil-water emulsion. The emulsifier used here has more oil solubility than water solubility. In the patent of Zoch, alcohol burnt in vapor phase but in the subject application alcohol remain in emulsion helps in emulsion stability and its formation. Ketone and ester will not be useful as co-surfactant. This action is not described Zoch and it is non-obvious for the Applicants' invention.

Zoch '868 discloses fuel additives in vapor phase while the Applicants' invention describes lube additive containing soluble cutting oil, which has water-oil liquid phase and is not used for combustion.

Otaki U.S. Patent No. 4,765,917 discloses water based lubricants on dies for metal forging (claim 1, 8, 9, 10 and 11). Forging means giving shape to molten metals on high temperature may be in thousands degree centigrade. At this temperature dies may stick together and to avoid this, some solid compounds are used. Water acts as a carrier here and after application it evaporates. Only salts go into action as solid layer on metals. In the subject application, for soluble cutting oil, additives remain in emulsion phase and works at comparatively lower temperature around 60 to 80 degree centigrade. There is a difference between forging and cutting and media are also different. Additives composition for soluble cutting oil can not be guess from patent of Otaki '917.

Otaki '917 uses a large portion of water-soluble substance including extreme pressure additive (phosphates, calcium carbonates, tri-metal salt, etc) in water based lubricant. In the Applicants' invention a large portion of additives including extreme pressure additives are oil soluble or dispersible.

Calcium carbonate in the Otaki patent acts as extreme pressure additive on high temperature to avoid fusion of both parts of dies. In the subject application calcium carbonate is used to provide mild alkalinity to keep the pH of emulsion at 7 or neutral, this is required when oleate emulsifier is used. Acidity may cause dissociation of oleate soap and loss of emulsifying properties. Oleate as emulsifier is preferred for further reduction of toxicity of the composition as oleate is less toxic than sulfonate. This aspect is not described in Otaki (US '917 patent thus, the Applicants invention is not obvious in view of Otaki.

A synergetic combination of additives and dosages is the invention which is claimed. A single additive in isolation is not claimed. Alkyl benzene and heavy alkyl benzene are not similar compounds. This is clear from the fact that manufacturer utilizes alkyl benzene (LAB or dodecyl benzene) and discards HAB.

Additionally, LAB/dodecyl benzene sulfonate is useful as house-hold detergent but HAB sulfonate is not useful as house-hold detergent because of a change in the structure. All the metal to metal contacts do not include the same desired working characteristics. For example, in metalworking one wants to cut/erode the surface, while in an engine one wants to protect the surface. All the lubricants are not the equivalent. Even all the metalworking fluids are not same i.e. soluble cutting oil, neat cutting oil, rolling oil, etc. Similarly, engine oil of two stroke engine and four stroke engine differ. Their purpose and requirements are different. Thus, one cannot assume that one component will work the same in two completely difference systems, products or methods. There must be a teaching or a suggestion of how it might work before claiming that the combination is obvious.

A comparison must even be done in the same category. Oleate used in bath soap should not be compared with oleate used in lube oil or metalworking fluid and that is why different patents were granted in the past for both of these.

In the prior art "heavy alkyl benzene" is not discussed. Only alkyl benzene is mentioned but for a different application. Metalworking fluid from mineral oil was found in prior art but metalworking fluid from heavy alkyl benzene was not found in prior art. The additive pack of synergistic component as mentioned in the subject application was not mentioned in prior art.

Comparison or equating HAB with other alkyl benzene is not justified. Metalworking fluid from other base oil was mentioned in prior art and it is obvious. The Applicants have many publications on water-oil-emulsifier behavior indicating the originality of their work. The Applicants have conducted more than 10 years of serious research work to reach this stage of their invention, wherein the purpose is to produce a less toxic product and to add value to a waste petrochemical. As there is no disclosure or combination of teachings which is similar to or teaches the Applicants' invention, i.e. a patent on metalworking fluid from heavy alkyl benzene, the subject application should be allowed.

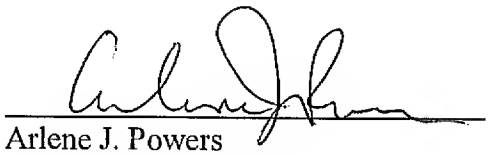
The Examiner has picked one small element from each of eight references. There is no suggestion or teaching to combine them. Additionally, even if they are combined as the Examiner states, one still does not arrive at the Applicants' invention. More specifically, a particular composition of compounds may work in an oil based system, but will not work the same in an oil/water system. Thus, the combination of small components of each reference without a teaching of how the components will work together should not be the basis of obviousness. The Examiner cannot use hindsight to determine that if an element is selected from each of the cited references that the Applicants' invention is obvious. It is not obvious and in fact, the combination is not even suggested.

In view of the foregoing, the Applicants contend that the amended claim and the claims dependent there from are in proper form. Applicants also respectfully contend that the teachings

of Anantaneni, U.S. Patent No. 6,630,430, in view of Boffa, U.S. Patent No. 5,804,537; Tanaka, U.S. Patent No. 6,245,725 B1; Camenzind, U.S. Patent No. 7,026,438 B2; Van Dam, U.S. Patent No. 6,784,142 B2; Matsushita, U.S. Patent No. 5,741,763; Zoch, U.S. Patent No. 3,902,868; and Otaki, U.S. Patent No. 4,765,917 do not establish a *prima facie* case of obviousness under 35 U.S.C. §103(a). Thus, claims 1-34 are considered to be patently distinguishable over the prior art of record and should be allowed.

The Commissioner is authorized to charge Deposit Order Account No. 19-0079 for any fees that may be required.

Respectfully submitted,



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A PROCESS FOR METALWORKING FLUID FROM HEAVY ALKYLATE

Field of Invention:

The present invention relates to a process for metalworking fluids from heavy alkylate. More particularly this invention relates to composition of metalworking fluid and process for its preparation based on heavy alkyl benzenes having 22 to 26 carbon atoms to replace mineral oil.

Background and Prior Art References:

Traditionally, the mineral oils and petroleum sulfonates have been the basic source of metalworking fluid formulations. The petroleum based lubricating oils and sulfonates are hydrocarbons of varying composition consisting of naphthenes, paraffins and aromatics. The sulfonates on the other hand formed by sulfonation of aromatic components in these lubricating oil streams act as oil/water emulsifiers. Besides these various additives, which are primarily chemicals of defined composition or structure, are added to the soluble oils to improve the physico-chemical properties and performance of metalworking fluids.

Petroleum based soluble oils, generally suffer from many disadvantages such as higher toxicity to the environment, poor biodegradability and ever-changing characteristics with changes in crude oil composition. The other types of lubricants known as synthetic lubricants are designed for use in extreme conditions of temperature, pressure, radiation or chemical environment and have excellent lubricity and thermal stability. The synthetic lubricants are

relatively costly as compared to petroleum based lubricants. Poly-glycols, polybutenes, dibasic acid esters, fluoropolymers, polyol esters, phosphate esters, silicones, poly-alpha olefins etc. are commonly used synthetic lubricants for various applications. Some of the synthetics are also toxic to environment and are not readily biodegradable. Similar disadvantages are found with Petroleum sulfonates which are by-products of sulfonation of lubricating oils also suffer from inconsistent emulsification and compatibility characteristics due to everchanging composition of the lubricating oils.

Keeping in the view the environmental concerns and improved performance, consistency in structural and performance characteristics, there is a need to develop alternative lubricant and emulsifier component, for metalworking fluids, which are less toxic and low cost which show equivalent or improved performance to mineral oil or synthetic lubricant based metalworking fluids.

The use of Heavy alkyl benzene as lubricant is very limited. Recently, the Heavy Alkyl Benzene alkaline earth metal sulfonates are in use as detergent-dispersant-anti rust additive in various types of lubricants.

Reference may be made to M/S Petresa, Madrid, Spain, (www.petresa.es) wherein they are marketing heavy alkylate under the brand name of 'PETRENE' to be use as thermal fluid, transformer oil, refrigerating oil, sulfonation feedstock and lubricating greases but not for metalworking fluids.

Reference may be made to M/s Chevron, U.S.A. Inc., (San Ramon, CA) has US patent 6,187,981 "Process for producing arylalkanes and arylalkanes sulfonates, compositions produced therefrom, and uses thereof". Wherein this invention is a process for producing aryl-alkanes. This invention also provides process that to produce modified alkylbenzene sulfonates, which can be used as detergents.

Chevron, U.S.A. Inc., (San Ramon, CA) has US patent 6,392,109 "Synthesis of alkylbenzenes and synlubes from Fischer-Tropsch products" which is for an integrated process for producing alkylbenzenes, sulfonated alkylbenzenes and/or alkylcyclohexanes from syngas and used as detergents and/or dispersants.

In view of the growing concern about the environment, there is a need for less-toxic lubricant component for metalworking soluble oil based on Heavy alkyl benzene, which is a new application of the heavy alkylate. It will not only reduce the toxicity of soluble oil but also will be more cost effective than mineral oil because of improved and consistent performance because both the mineral oil component and the sulfonates made from these alkylates can be tailored to obtain a high performance product of consistent quality. It is an additional benefit to the alkylate industry.

Objects of the Invention:

The main object of the present invention is to provide a process for metalworking fluids from heavy alkylate.

Another object of the present invention is to provide heavy alkylate based less toxic lubricant component metalworking fluids.

Still another objects of the present invention is to provide a new application to the by-product heavy alkylate.

Yet another object of the present invention is to provide new composition of metalworking fluid for the benefit of metalworking and alkylate manufacturing industries.

Summary of Invention:

The present invention relates to a process for metalworking fluids from heavy alkylate. More particularly this invention relates to composition of metalworking fluid and process for its preparation based on heavy alkyl benzenes having 22 to 26 carbon atoms to replace mineral oil.

The speed of machining could be greatly increased if the cutting surface is kept cool and lubricated. Water can be regarded as the first cutting fluid because of its high specific and latent heats to give it unique potential cooling power and also it is available everywhere at low cost. However, due to poor wetting efficiency, water alone can't cool the metal surface with its full ability. Another serious disadvantage is the formation of rust on iron and steel surfaces. Modern development has led to the introduction of advanced water-oil emulsion incorporating special chemicals, which considerably improve its wettability, lubrication, high cooling power, rust inhibiting and detergency properties. These concentrates and their

emulsions in water are known as 'Soluble Oil'. They are ideal for general machining process where Cooling, Lubrication, Cleaning and extreme pressure characteristics are essential requirements.

Detailed description:

Accordingly the present invention provides a process for metalworking fluid from heavy alkylate, which comprises ;

(a) residual fraction having C20 to C22 carbon atom of detergent class Alkyl Benzene in the concentration range of 50 to 90 weight percent of the metal working fluid , (b) at least one emulsifier in the range of 10 to 40 weight percent of the metalworking fluid, (c) at least one lubricity booster component in the concentration range of 2-10 percent of metal working fluid, (d) an antioxidant component is in the concentration range of 50-500 ppm, (e) a fungicide component in the concentration range of 50-500 ppm, (f) an extreme pressure additive component in the concentration range of 50-500 ppm (g) an antirust component in the concentration range of 50-500 ppm, (h) a co-surfactant component in the range of 1-10 weight percent of metal working fluid, (i) a coupling agent in the range of 0.5 to 10 weight percent of metal working fluid, (j) alkali component in the range of 8-10 weight percent of metal working fluid.

Heavy alkyl benzene is produced as by-products during the preparation of linear alkyl benzene sulfonates for detergent industry. The alkylation reaction of C_{10}-C_{14} olefin with benzene results in side reactions to give dialkyl benzenes and alkylated condensed ring derivatives. These products are generally in the range of 5 to 15 percent of the total alkylates

depending upon the reaction conditions and purity of reactants employed. Heavy alkyl benzene consists of substituted benzenes and Naphthalenes as determined by HPLC, UV, IR and RI analysis given in Table - 1. The typical properties such as density, kinetic viscosity, viscosity index, refractive index, pour point, molecular weight and distillation characteristics were given in Table - 2. No poly-aromatics or olefinic compounds are present in the heavy alkylates. These heavy alkylates have been acquired from the Indian market.

Table – 1

Typical Relative Content of Alkyl Benzenes and Alkyl Napthalenes

Components	HAB - I		HAB – II	
	IR	UV 254	IR	UV 254
Alkyl Benzenes % by wt.	84 ± 2	84±2	93±2	90±2
Alkyl Napthalenes % by wt.	15±2	16±2	7±2	10±2

Table - 2

Typical Characteristics of Heavy Alkyl Benzenes

Characteristics	**HAB – I**	**HAB – II**
Density at 15°C	0.8839	0.8813
K. Viscosity Cst at 40°C	28.95	26.93
K. Viscosity Cst at 100°C	4.50	4.31
Viscosity Index	37	32
Pour Point °C	(-) 27	(-) 25
Molecular wt.	365±5	361±5
Distillation range °C (ASTM D1160)	225 - 440	226 – 515
Refractive index at 20°C	1.4946	1.4916

In an embodiment of the present invention the oil component is a heavy alkyl benzene having C20 – C22 carbon number, a heavy fraction, by-product, separated from detergent class alkyl benzene during manufacture.

In another embodiment of the present invention the concentration of heavy alkyl benzene component is in between 50 to 90 weight percent of the metalworking fluid.

In yet another embodiment of the present invention the emulsifier component is a heavy alkylate sodium sulfonates, sodium carboxylate, sodium oleate, Triethalonoamine oleate, Diethalonoamine oleate or Dodecyl Toluene sodium sulfonate or mixtures thereof.

In still another embodiment of the present invention the concentration of emulsifier component is in between 10 to 40 weight percent of the metalworking fluid.

In still another embodiment of the present invention the vegetable oil component for lubricity booster is a karanja oil, neem oil, rice-bran oil, castor oil or mixtures thereof.

In still another embodiment of the present invention the concentration of vegetable oil component for lubricity boost is in between 2 to 10 weight percent of the metalworking fluid.
In still another embodiment of the present invention the antioxidant component is an alkyl phenol or aromatic amine or substituted alkyl phenol selected from 2,6-ditertiary butyl phenol, 2,6-ditertiary p-cresol, Diphenylamine, Tertiary butyl phenol amino tetrazole and 2,6-dioctyl phenylene diamine.

In still another embodiment of the present invention the concentration of antioxidant component is in between 50 to 500 ppm.

In still another embodiment of the present invention the fungicide component is a phenol or phenolic acid selected from o-cresol, phenol, m-cresol and cresylic acid.

In still another embodiment of the present invention the concentration of fungicide component is in between 50 to 500 ppm.

In still another embodiment of the present invention the extreme pressure additive component is an organic sulfide or phosphosulfurized metal salt selected from dibenzyl disulphide, sulfurized vegetable oil, phosphosulfurized decyl oleate molybdate and phosphothio pentadecyl phenol molybdate.

In still another embodiment of the present invention the concentration of extreme pressure additive component is in between 50 to 500 ppm.

In still another embodiment of the present invention the anti-rust component is a triazole or sulfonate selected from 1H-benzotriazole, ditertiary butylated 1H-Benzotriazole, calcium petroleum sulfonate and calcium heavy alkylate sulfonate.

In still another embodiment of the present invention the concentration of ant-rust component is in between 50 to 500 ppm.

In still another embodiment of the present invention the co-surfactant component is a alcohol selected from isopropanol, n-butanol, iso-butanol, iso-amyl alcohol, 2 ethyl hexanol, mono & poly glycol such as di ethylene glycol and tri ethylene glycol.

In still another embodiment of the present invention the concentration of co-surfactant component is in between 1 to 10 weight percent of the metalworking fluid.

In still another embodiment of the present invention the coupling agent component is a sulfonates (molecular weight less than 350) selected from ligno sulfonate, petroleum sulfonate, sodium dodecyl benzene sulfonate and sodium lauryl sulfate.

In still another embodiment of the present invention the concentration of coupling agent component is in between 0.5 to 10 weight percent of the metalworking fluid.

In still another embodiment of the present invention the alkali component is a alkali and alkaline earth metal salt selected from sodium carbonate, sodium hydrogen carbonate, calcium carbonate, calcium oxide.

In still another embodiment of the present invention the concentration of alkali component is in between 0.5 to 8 weight percent of the metalworking fluid.

In still another embodiment of the present invention the composition is suitable for use as metal working fluid and general emulsion as admixture with water in concentration ranging from 20 to 80 weight percent.

In yet another embodiment of the present invention the emulsion of the soluble cutting oil may be prepared by:

I. stirring the fluid with 60 to 90 wt % water to convert the fluid into emulsion,

II. wherein the emulsion is useful as soluble cutting oil,

III. wherein the emulsion is useful as a coolant,

IV. wherein the emulsion has less toxicity than mineral oil.

After the addition of all the components the mixture is homogenized. Then it is conditioned by keeping it at room temperature for 24 hours undisturbed. Dilute emulsion of the soluble oil may be prepared by mixing the concentrate in water with vigorous agitation for 1 to 5 minutes in the ratio of ~~20:80 to 80:20~~ 60 to 90 wt% as per requirements of the metal work and nature of metal.

It will be apparent from the foregoing that the present invention provides non-toxic lubricant component by using heavy alkyl benzene and useful for making formulation for metalworking soluble oil. This invention further provides a suitable new application for heavy alkyl benzene as a by-product to increase its value.

The invention will now be further described by the following examples, which are given only for the purpose of illustration and not intended to limit the scope of the invention. Although the invention has been described in conjunction with examples and by reference to the embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in art in light of the foregoing description, accordingly it is intended in the invention to embrace these and all such alternatives, variations and modifications as may fall with in the sprit and scope of the appended claims.

Example – 1

After removal of insoluble matter, the heavy alkyl benzene in 65 weight percent was mixed with heavy alkyl benzene sodium sulfonate in 10 weight percent and karanja oil 5 weight percent of metalworking fluid as component for lubricity. The mixture was homogenized at

30 to 100°C for one hour with stirring to obtain clear solution. Then ligno sulfonate as coupling agent in concentration of 5 weight percent of the fluid, 2,6, ditertiary butyl 4 methyl phenol 100 ppm as antioxidant, cresylic acid 100 ppm as fungicide, dibenzyl disulfide 100 ppm as extreme pressure additive, 1H-benzotriazole 100 ppm as antirust additive and isobutanol 5 weight percent of the metalworking fluid as co-surfactant were added. The mixture was further homogenized for 30 minutes. Water was added to make-up quantity to 1 kg and further homogenized for 30 minutes. The pH of the solution was adjusted to 7 – 9 by adding sodium carbonate. The solution was cooled down to room temperature with stirring. The final composition (HA – 1) is given in Table – 3. The neat soluble oil then mixed with water in ~~60:40~~ 60 to 90 wt % ratio and shaken to produce oil-water emulsion. This emulsion was evaluated for its different characteristics, which are given in Table – 4 and 5. It was found that the characteristics of the neat and emulsion are at par with the specifications.

Table – 3

TYPICAL COMPOSITION OF SOLUBLE OIL

SN	Constituents	HA-I	HA-II	HA-III
1	Heavy Alkyl Benzene %	65	60	75
2	Emulsifier %	10	15	10
3	Additives ppm	400	350	450
4	Co-surfactant %	6	5	7
5	Lubricity Additive	5	5	5
6	Coupling agent %	4	6	3
7	Alkali %	1 approx.	1 approx.	1 approx.
8	Water %	5 - 10 approx.	5 - 10 approx.	5 - 10 approx.

Example – 2

The procedure of Example 1 was repeated with alkylate 60 weight percent except that Dodecyl Toluene Sodium Sulfonate 15 weight percent was taken as emulsifier in place of Heavy Alkyl Benzene Sodium Sulfonate, neem oil as component for lubricity in place of karanja oil, 2,6-dioctyl phenylene diamine as antioxidant in place of 2,6,-ditertiary butyl 4-

methyl phenol, m-cresol as fungicide in place of cresylic acid, phosphothio pentadecyl phenol as extreme pressure additive in place of dibenzyl disulphide. The final composition (HA – I1) is given in Table – 3 and evaluation in Table-4 & 5.

Example – 3

The procedure of Example 1 was repeated with alkylate 75 weight percent except that Sodium Oleate 10 weight percent was taken as emulsifier in place of Heavy Alkyl Benzene Sodium Sulfonate. The final composition (HA – II1) is given in Table – 3 and evaluation in Table-4 & 5. It was found that the characteristics of the neat and emulsion are as per requirement.

Table – 4

TYPICAL CHARACTERISTICS OF SOLUBLE OIL

SN	Formulation	K.Viscosity 40°C - Cst	Total Acid No-mg KOH	Ash %	Clarity	Flash Point-°C	Reactable Sulfur at 100°C
1	HA-I	23.3	NIL	0.009	Clear	210	NIL
2	HA-II	26.2	NIL	0.008	Clear	215	NIL
3	HA-III	24.5	NIL	0.006	Clear	213	NIL

Table – 5

TYPICAL EVALUATION OF SOLUBLE OIL

SN	Formulation	Copper corrosion	Deposit test	Emulsion stability	Cast iron rust	Saponification value – mg KOH	Low temp Stability	Frothing Test
1	HA- I	< 1	NIL	Pass	Pass	4.8	Pass	Pass
2	HA- II	< 1	NIL	Pass	Pass	4.5	Pass	Pass
3	HA- III	< 1	NIL	Pass	Pass	4.6	Pass	Pass

What is now claimed: